

UPRIGHT HINGE FOR SPA COVER

CROSS-REFERENCE TO RELATED APPLICATION(S)

This application includes subject matter related to  
5 U.S. Patent Application No. \_\_\_\_\_ (Attorney  
Docket No. 50229/MEG/F314) filed on the even date herewith,  
the contents of which are incorporated by reference herein.

FIELD OF THE INVENTION

10 This application is related to a hinge between a spa  
and a spa cover, and more particularly, to a hinge that  
allows a spa cover to be stowed in an upright position when  
the spa is open.

15 BACKGROUND

Commercially available spas typically have a spa cover  
to prevent dirt or dust from entering therein. To open the  
spa, a spa cover is typically folded in half, hingedly  
lifted off the top of the spa, and lowered vertically  
20 behind the spa so as to reduce its obstruction of view to a  
person using the spa. However, such lowering and stowage  
of the spa cover typically requires an area behind the spa  
that may be larger than available in a small backyard.

To accommodate those without sufficient room to stow  
25 the spa cover behind the spa, some spa covers are kept in  
an upright position when the spa is fully open. This way,  
less room is typically required behind the spa. However,  
spa covers in an upright position are more susceptible to a  
gust of wind that blows against it from the rear or other  
30 forces that tend to close the spa cover when an occupant is  
in the spa.

U.S. Patent Publication No. 2002/0050003 filed by Perry ("Perry I") discloses a gas spring lock for engaging and locking a gas spring in the extended position so that covers of spas, hot tubs and other similar apparatus that employ gas springs can be safely locked into an open position.

U.S. Patent No. 6,000,071 issued to Fettes ("Fettes I") discloses an apparatus for aiding removal and replacement of a spa cover. Fettes I discloses a lifting system for exerting a lifting force on an arm attached to the spa cover, tending to lift the arm as the arm moves from the covering position toward the uncovering position, and for exerting a resistance force on the arm tending to resist movement of the arm from the uncovering position toward the covering position.

U.S. Patent No. 5,950,252 issued to Fettes ("Fettes II") discloses a device for aiding in the removal and replacement of a spa cover atop a spa tub. FIGs. 11-13 disclose a spa cover that is stowed at an upright position.

U.S. Patent No. 5,689,841 issued to Black et al. ("Black et al.") discloses a spa cover lifting apparatus which can be adjusted to accommodate spa covers of different sizes. The lifting action of the apparatus is assisted by a telescoping gas strut.

In each of the above publication and patents, a gas spring forms an angle that is more than 45 degrees with respect to the top of the spa when the spa cover is in a fully open position.

U.S. Patent No. 5,819,332 issued to Perry ("Perry II") discloses a spa cover removal apparatus. As seen in FIG. 8, the gas spring 63 can assume an infinite number of

positions thereby providing a wide range of adjustment for the amount of load it assumes to resist.

U.S. Patent No. 4,899,420 issued to Bye et al. ("Bye et al.") discloses a hinge system for a large or heavy cover member hinged to a container member. A container hinge plate is secured to a side wall of the container member. A cover hinge plate is secured to a side wall of the cover member and rotatably connected to the first hinge means at a hinge pivot means. Bye et al. also discloses a gas strut that appears to form an angle that is less than 45 degrees with respect to a horizontal plane. The cover member pivots with respect to the container member about the same axis as the axis of rotation between the container hinge plate and the cover hinge plate.

U.S. Patent No. 6,195,811 issued to Dragovic ("Dragovic") discloses a spa cover mounting method and apparatus. Dragovic discloses that a foam spa cover member is attached to a cover lifter apparatus using a plurality of brackets.

#### SUMMARY

In an exemplary embodiment according to aspects of the present invention, a hinge assembly for coupling a spa cover to a spa is provided. The spa cover is movable between a fully closed position and a fully open position. The hinge assembly includes: a mounting bracket disposed near a top of the spa; a support arm which is pivotably coupled to the mounting bracket about an axis of rotation, and attached on an outside surface of the spa cover at a vertical offset from the axis of rotation when the spa cover is in the fully closed position; and a spring member disposed between the mounting bracket and the support arm.

The spring member forms an angle of less than approximately 45 degrees with respect to the top of the spa when the spa cover is in the fully open position.

5 In another exemplary embodiment according to aspects of the present invention, a spa system is provided. The spa system includes a spa; a foldable spa cover having at least two sections, and a hinge assembly for coupling the spa cover to the spa. The spa cover is movable between a fully closed position and a fully open position. The hinge  
10 assembly includes: a mounting bracket disposed near a top of the spa; a support arm which is pivotably coupled to the mounting bracket about an axis of rotation, and attached on an outside surface of the spa cover at a vertical offset from the axis of rotation when the spa cover is in the  
15 fully closed position; and a spring member disposed between the mounting bracket and the support arm. The spring member forms an angle of less than approximately 45 degrees with respect to the top of the spa when the spa cover is in the fully open position.

20 In yet another exemplary embodiment according to the aspects of the present invention, a method of mounting a hinge mechanism between a spa and a spa cover having a core and a cover is provided. The method includes: affixing at least one metal plate on an external surface of the cover  
25 using an adhesive, said at least one metal plate having a hole; and inserting a screw and an anchor engaging the screw through the hole on said at least one metal plate into the spa cover, wherein said adhesive can provide sealing to the cover.

30 These and other aspects of the invention will be more readily comprehended in view of the discussion herein and

accompanying drawings, in which like reference numerals designate like elements.

BRIEF DESCRIPTION OF THE DRAWINGS

5        FIG. 1 is a side view of a hinge assembly (in a closed position) that couples a spa cover to a spa in an exemplary embodiment according to aspects of the present invention;

      FIG. 2 is a perspective view of the hinge assembly coupled to a side mount support bracket and a brace of FIG.  
10 1;

      FIG. 3 is a perspective view of a support arm in an alternate embodiment;

      FIG. 4A is a view of the side mount support bracket and the mounting bracket as seen from behind the spa;

15        FIG. 4B is a perspective view of the mounting bracket of FIG. 1 mounted on top of the side mount support bracket;

      FIG. 5 is a perspective view that illustrates a locking mechanism between a support arm and a mounting bracket in an alternate embodiment;

20        FIG. 6 is a side view of a metal plate assembly in an exemplary embodiment in accordance with aspects of the present invention;

      FIG. 7 illustrates the metal plate assembly of FIG. 6 being mounted on a spa cover;

25        FIG. 8 is a side view of the hinge assembly (in an open position), spa cover and spa of FIG. 1;

      FIG. 9 is a side view of the hinge assembly, spa cover and spa of FIG. 1, in which the spa is enclosed in a deck; and

30        FIG. 10 is a side view of the hinge assembly (in an open position), spa cover, spa and deck of FIG. 9.

## DETAILED DESCRIPTION

FIG. 1 is a side view of a hinge assembly 106 that couples a spa cover 102 to a spa 100 in an exemplary embodiment according to aspects of the present invention.

5 The spa 100 includes an outer wood frame 101 surrounding an inner spa 103. The inner spa 103, for example, may be fabricated using fiberglass.

In FIG. 1, the spa is in a closed position, where the spa cover 102 completely covers the opening of the spa.  
10 The spa cover is foldable at a fold line A-A into two substantially rectangular sections that are approximately equal in size. When opening the spa, the spa cover is first folded into two sections, one on top of the other, and then the folded spa cover is rotated about the rear  
15 edge at the top of the spa to completely open the spa.

The hinge assembly 106 is mounted near the rear edge and on the outer wooden frame 101 of the spa when viewed from the left side of the spa. There is provided another hinge assembly on the right side of the spa 100, which is  
20 hidden from view in FIG. 1. The right side hinge assembly has substantially the same configuration as the hinge assembly 106, except that the right side hinge assembly when viewed from the right side is a mirror image of the hinge assembly 106. Therefore, the hinge assembly will be  
25 described in reference to the left side hinge assembly 106 with an understanding that the right and left side hinge assemblies have substantially the same configuration (but with a mirror image) as each other.

With reference also to FIG. 2, the hinge assembly 106  
30 includes a support arm 108, a mounting bracket 112 and a spring member 110. The spring member may help with the lifting of the spa cover 102. Further, the spring member

may provide resistance against closing of the spa cover 102. The spring member 110, for example, may be a gas spring. It should be noted that the spring member 110 is mounted outside the spa, and not inside. The hinge  
5 assembly is mounted on the spa using a side mount support bracket 114 and a brace 116 that are fixedly mounted on the left side of the spa (i.e., outer wooden frame 101).

The spring member 110 is pivotably coupled to a pivot 118 on an end (i.e., the end away from the rear edge of the  
10 spa) of the mounting bracket 112 and a pivot 120 on the support arm 108. In the exemplary embodiment, the location of the pivot 120 on the support arm 108 is fixed. The resistance provided by the spring member 110 can be adjusted, for example, by replacing it with stronger or  
15 weaker spring members (e.g., gas springs).

The angle the spring member 110 forms with respect to the top of the spa when the spa is fully open is fixed at approximately 15 degrees in the described exemplary embodiment. In other exemplary embodiments, however, the  
20 angle between the spring member 110 and the top of the spa may be different. For example, the angle the spring member 110 forms with respect to the top of the spa when the spa is fully open may be approximately 45 degrees, less than 40 degrees, less than 30 degrees, less than 20 degrees or less  
25 than 15 degrees in various different embodiments. In alternate embodiments, the location of the pivot 120 may be adjusted on the support arm 108 so as to change the resistance provided by the spring member.

The support arm 108 has an elongated arm section 130,  
30 a short arm section 134 and a connecting member 132 disposed between the elongated arm section 130 and the short arm section 134. The connecting member 132 forms an

angle with respect to the elongated arm section and also with respect to the short arm section. This way, the spa cover 102 attached to the elongated arm section 130 can be lifted up slightly and away from the spa as the support arm 108 is rotated with respect to the mounting bracket 112 about the pivot 122 to place the spa cover in a fully open position. In other words, the support arm 108 is shaped to enable the spa cover to be lifted up from the top of the spa and not aligned with an axis of rotation as the support arm is pivotably rotated with respect to the mounting bracket 112 to place the spa cover in a fully open position. Otherwise, the spa cover 102 may jamb against the top of the spa during the opening process.

The elongated arm section 130 has two holes formed thereon at the end away from the connecting member 132. These holes may be used to attach the elongated arm section 130 to the spa cover as will be described later. The elongated arm section 130 also has two holes formed thereon about two-thirds of the way between the end having two holes and the connecting member 132. These holes may also be used to attach the elongated arm section 130 to the spa cover as will be described later.

The short arm section 134 has formed thereon a hole for coupling the spring member thereto to form the pivot 120. In alternate embodiments, the location of the pivot 120 and therefore the hole for the same may be moved to adjust the resistance provided by the spring member against closing of the spa cover as described above. Each of the arm sections and the connecting member has a substantially rectangular cross-section in the exemplary embodiment.

The support arm 108 may have other configurations in other embodiments. For example, the arm sections and the



connecting member may have cross-sections that are different from a rectangular cross-section. Further, in an alternate embodiment as depicted in FIG. 3, a support arm 109 may include an elongated arm section 131 connected to a short arm section 135 through a connecting member 133 that has a curvature. In the alternate embodiment of FIG. 3, the short arm section 135 may be pivotably connected to a mounting bracket to form a pivot while the elongated arm section 131 is attached along the side of one of the two foldable spa cover sections. Due to the curvature of the connecting member 133, a spa cover attached to the elongated arm section 131 can be lifted up slightly and away from the spa as the support arm 109 is rotated with respect to a mounting bracket about a pivot to place the spa cover in a fully open position. Otherwise, the spa cover may jamb against the top of the spa during the opening process.

Returning now to FIGs. 1 and 2, the mounting bracket 112 includes a web 136 that has a shape of an elongated rectangle. The web 136 has attached thereon substantially vertical lips 138 and 140 that run substantially in parallel along the side of the web 136 through substantially the whole length of the web 136. The lips 138 and 140 also have a substantially elongated rectangular shape.

The lip 138 has formed thereon semi-elliptical protrusions 142 and 144, respectively, on its ends. The semi-elliptical protrusion 142 has formed thereon a hole for forming the pivot 118 between the spring member 110 and the mounting bracket 112. The other lip 140 has formed thereon only one semi-elliptical protrusion 146 that faces the semi-elliptical protrusion 144 on the lip 138. The

protrusion 146 has formed thereon a hole for forming the pivot 122 between the mounting bracket 112 and the support arm 108, and the protrusion 144 also has formed thereon a hole (not shown) for forming the pivot 122 together with  
5 the hole on the protrusion 146.

The web 136 of the mounting bracket 112 is mounted on top of and attached to the side mount support bracket 114. The side mount support bracket 114 is L-shaped having a substantially rectangular horizontal member 148 and a  
10 substantially rectangular vertical member 150. The horizontal member 148 may have formed thereon one or more holes for mounting the mounting bracket 112 on the horizontal member 148. The mounting bracket 112 may also have holes that match the holes on the horizontal member  
15 148. The vertical member 150 may have formed thereon one or more holes for fastening the side mount support bracket on the side of the outer wooden frame 101 near the rear edge and close to the top of the spa.

The installation of the side mount support bracket 114  
20 and the mounting bracket 112 on the outer wooden frame 101 may best be described in reference to FIGs. 4A and 4B. It can be seen that the inner spa 103 has a lip portion 113 at the top that protrudes over and out of the outer wooden frame 101. The vertical member 150 is installed on the  
25 outer wooden frame right below the lip portion 113, where the top surface of a portion of the horizontal member 148 abuts the underside of the lip portion 113. A major portion of the horizontal member 148 is not under the lip portion 113, and the mounting bracket 112 is mounted on  
30 this major portion of the horizontal member 148.

As can be seen in FIGs. 2 and 4B, the mounting bracket 112 is not mounted through its entire length on the

horizontal member 148 of the side mount support bracket 114. Instead, an end portion where the pivot 122 is located protrudes over and out of the edge of the horizontal member 148. Further, the edge of the mounting  
5 bracket 112 on the side where the pivot 118 is located does not extend all the way to the edge of the horizontal member 148.

Returning now to FIGs. 1 and 2, the brace 116 has a substantially elongated rectangular shape. In one  
10 embodiment, the ends may be rectangular. In other embodiments, one or both ends may taper so as to form a substantially triangular or trapezoidal shape at one or both ends. The brace 116 is attached on the vertical member 150 at one end thereof at an angle such that the end  
15 of the brace 116 away from the attachment location with the vertical member 150 points downward and toward the front of the spa. The downward pointing end of the brace 116 is attached to the outer wooden frame 101 so as to provide a structural support to the side mount support bracket 114.

20 In other embodiments as illustrated, for example, in FIG. 5, a hinge assembly may include a locking mechanism to hold the spa cover 102 in an upright position. In the embodiment of FIG. 5, a support arm 111 is hingedly coupled to a mounting bracket 115 about a pivot 123. The mounting  
25 bracket has lips 139 and 141 coupled through the whole length of a web 137, and formed thereon protrusions 145 and 147 that face each other, and on which respective holes for forming the pivot 123 have been formed.

The protrusions 145 and 147 also have formed thereon,  
30 respectively, two holes 125 and 127 for installing a safety lock pin 155. The safety lock pin 155 has formed thereon a locking ball for holding the pin 155 in place once it is

installed through the holes 125, 127, and a chain 159 for attaching it to a stationary object so that the safety lock pin does not get lost. When the support arm 111 is in an open position and the safety lock pin 155 is installed (i.e., the locking mechanism has been engaged), the support arm 111 does not rotate with respect to the mounting bracket 112 because the safety lock pin 155 engages an end of the support arm, and physically prevents it from rotating towards a closed position.

Returning now to FIG. 1, the support arm 108 is fixedly attached to the spa cover 102 at two locations along the length of the spa cover. Both the attachment locations are on only one of the two spa cover sections (e.g., on the spa cover section that is under the other spa cover section when the spa cover is folded) so that the support arm need not be folded in a similar manner when folding the spa cover in two. At each attachment location, two parallel bolts or screws are used to fasten the support arm to the spa cover. In other embodiments, the support arm may be attached at more than two attachment locations on the spa cover section. Further, more or less than two bolts or screws may be used at each attachment location in other embodiments.

To support the attachment of the support arm 108 to the spa cover 102 at two attachment locations, two metal plates 104 and 105 are first mounted on the spa cover 102. In FIG. 1, the metal plates 104 and 105 are shown as rectangles having dotted lines along the left side edge of one of the spa cover sections. They are shown in dotted lines because they are at least partly hidden from view behind the support arm 108.

The metal plates 104 and 105 have a width that is substantially the same as the width of the support arm 108. In other embodiments, the width of the metal plates may be more or less than the width of the support arm 108.

5 Further, a different size and/or number of metal plates (e.g., one long metal plate that runs along the length of one of the sections of the spa cover 102) may be used. A detailed description of installation and operation of the metal plates 104 and 105 is provided below in reference to

10 FIGs. 6 and 7.

FIG. 6 illustrates a side view of a metal plate assembly in an exemplary embodiment in accordance with aspects of the present invention. The metal plate assembly includes the metal plate 104, a double sided tape 172, a

15 screw 170 and an anchor 174. It should be noted that while the metal plate assembly is described in reference to metal plate 104 of FIG. 1, the metal plate 105 (and any other metal plates used) may have substantially the same configuration. For example, when an angle formed of two

20 adjoining plates is used, one of the plates may be inserted into the spa cover and/or its core. A slit may be preformed on the spa cover and/or the core to accommodate the insertion of that plate of the angle.

The metal plate 104 may be formed from aluminum and

25 may have a rectangular shape and size varying, for example, between approximately 1" x 4" (2.54 cm x 10.16 cm) and approximately 1.75" x 2" (4.445 cm x 5.08 cm). The metal plate may have other dimensions in other embodiments. Further, the metal plate may have any other suitable shape

30 such as angle, channel and the like.

The double sided tape 172 may cover one side of the metal plate 104 completely, and is affixed to the metal

plate. The adhesive on the side away from the metal plate should remain covered until the metal plate (and the double sided tape) is ready to be affixed to a spa cover. The double sided tape 172 may, for example, be a .030 heavy  
5 duty doubled sided tape.

The screw 170, for example, may be a flat head Phillips drive drywall screw or any other suitable screw. The screw 170 may, for example, have a length of approximately 6" (15.24 cm), and may be coarsely threaded.

10 The anchor 174 is formed from an elongated metal strip that is approximately 2.5" (6.35 cm) in length. The anchor 174 is bent about its middle to form an elongated "U" shape. The anchor 174 has a hole about its middle that can be used to engage the thread on the screw 170. Hence, the  
15 anchor 174 may be described as an U-shaped member having a base with hole and two elongated wings. The anchor 174 has a pointed tip at both ends 176 and 178 (e.g., of the two wings), so that the wings can penetrate the material into which the anchor is embedded. The anchor may have other  
20 suitable shapes in other embodiments. The anchor 174 is deformable so that it can at least partly be unbent during the installation process.

FIG. 7 illustrates the metal plate assembly of FIG. 6 being mounted on a spa cover 102. The spa cover 102 has a  
25 core 162 (which may be formed from a solid block of foam) covered by a cover 160 (which may be formed from vinyl). In other embodiments, other suitable materials other than foam and/or vinyl may be used to fabricate the core and/or the cover, respectively. It should be noted that while the  
30 installation of the metal plate assembly is described in reference to metal plate 104 of FIG. 1, the metal plate 105

(and any other metal plates used) may be installed in substantially the same manner.

During installation, the sticky portion not affixed to the metal plate of the double sided tape 172 should first  
5 be exposed so that the double sided tape 172, and therefore the metal plate 104, can be affixed on the cover 160. Then, the screw 170 is nailed (i.e., pounded in and not screwed) through a hole on the metal plate 104 and the cover 160 into the core 162 without removing the cover 160.  
10 This way, the steps of removing the cover and then reinserting the core into the cover may be avoided. In other embodiments, however, the cover may be removed to install the metal plates directly on the core. Since the anchor 174 engages the thread of the screw 170, the anchor  
15 is inserted into the core 162 together with the screw 170.

The metal plate may be affixed to the cover 160 via the double sided tape 172 at any time before, during or after nailing the screw 170 into the core 162. The  
adhesive on the double sided tape 172 may form a seal  
20 around the opening on the cover 160 formed by driving in the screw 170 so as to prevent moisture from entering inside the cover 160.

With the metal plate and the screw (and the anchor) in place, the screw is rotated to attach it firmly to the core  
25 162. That is, at the time of inserting the screw into the core 162, the anchor 174 has an outline and relative location similar to that of a dotted outline 174a. As the screw is rotated, the anchor 174 travels towards the head of the screw 170 since the hole at the center of the anchor  
30 is engaging the thread of the screw 170. Moving towards the screw head, the anchor 174 is deformed since its movement is resisted by the core 162, which may be a solid

block of foam material. Hence, during the process, the anchor has an outline and relative position 174b, for example, where the anchor has partially unbent wings due to the resistance provided by the core 162. As can be  
5 imagined, it would be harder and harder to turn the screw 170 since the resistance provided by the core 162 increases. Finally, the anchor may have an outline and relative position 174c when the screw is finally firmly anchored within the core 162, and the wings of the anchor  
10 174 are further spread out.

FIG. 8 is a side view of the hinge assembly 106, spa cover 102 and spa 100 of FIG. 1, where the spa is in an open position. It can be seen that the spa cover 102 forms an approximately 90 degree angle with respect to the top of  
15 the spa. Further, the spa cover 102 is in an upright position, where it is not vertically moved downward (e.g., behind the spa) to reach a fully open position. The short arm section 134 of the support arm also forms an approximately 90 degree angle with respect to the top of  
20 the spa 100. This way, the requirement for room or space behind the spa 100 may be reduced, as compared to a spa whose cover is stowed behind the spa.

The spring member 110 (e.g., a gas spring) is in a fully extended position when the spa is fully open. It can  
25 be seen that the spring member forms an angle of approximately 15 degrees with respect to the top of the spa so that the spring member 110 provides a resistance against the gust of wind blowing from behind the spa cover or other forces that tend to close the spa cover in the upright  
30 position. In alternate embodiments, by adjusting the location of the pivot 120 on the short arm section 134, the



resistance in the horizontal direction provided by the spring member 110 may be adjusted.

The support arm 108 is pivotably coupled to the mounting bracket 112 at a pivot 122. As can be seen from  
5 FIGs. 1 and 8, the pivot 122 is not aligned with the rear edge of the spa 100 nor is the pivot attached to the spa cover 102. This way, the spa cover 102 is not placed over the axis of rotation about the pivot 122 between the support arm 108 and the mounting bracket 112 when the spa  
10 cover is in a fully open position. This is also made possible by the angled connecting member 132 of the support arm 108 that displaces the elongated member 130 (to which the spa cover is attached) from the axis of rotation about the pivot 122 when the spa cover is in the fully open  
15 position.

FIG. 9 is a side view of the hinge assembly 106, the spa cover 102 and the spa 100 of FIG. 1, where the spa cover 102 is in a closed position. The spa 100 is enclosed in a deck 200 except for a small portion at the top (e.g.,  
20 top of the inner spa 103). The deck 200 may be made of wood or any other suitable material. In other embodiments, the deck may only partially enclose the spa.

The operation of the hinge assembly 106 is substantially the same as that of the hinge assembly of  
25 FIGs. 1, 2 and 8. One difference is that the hinge assembly 106 is not mounted on the side mount support bracket 114 or the brace 116. Instead, the mounting bracket 112 is mounted directly on the deck 200, which provides support to the hinge assembly 106.

30 FIG. 10 is a side view of the hinge assembly 106, the spa cover 102 and the deck 200 of FIG. 9, where the spa cover 102 is in an open position. The operation of the

hinge assembly 106 is substantially the same as that of the hinge assembly 106 of FIGs. 1, 2 and 8. It can be seen in FIG. 10 that the spring member 110, when the spa is fully open, forms an angle with respect to the top of the spa that is approximately 15 degrees. Such small angle between the spring member 110 and the top of the spa provides additional resistance against force, e.g., gust of wind, that tend to close the spa cover 102, as compared to the spring members that form an angle greater than approximately 45 degrees.

It can also be seen in FIG. 10 that the spa cover 102 rests at the top of the deck 200. This is possible at least partly due to the fact that the spa cover 102 is not connected directly to the pivot 122 and that the angled connecting member 132 allows the spa cover 102 to be slightly lifted up off the top of the spa 100 as the support arm 108 rotates about the pivot 122. In other words, the support arm 108 is shaped to enable the spa cover 102 to be lifted up from the top of the spa and not aligned with an axis of rotation as the support arm is pivotably rotated with respect to the mounting bracket 112 to place the spa cover in a fully open position, and to enable the spa cover 102 to rest directly on the deck 200.

It will be appreciated by those of ordinary skill in the art that the invention can be embodied in other specific forms without departing from the spirit or essential character thereof. The present invention is therefore considered in all respects to be illustrative and not restrictive. The scope of the invention is indicated by the appended claims, and all changes that come within the meaning and range of equivalents thereof are intended to be embraced therein.